BUBBLES' OSCILLATIONS IN LIQUIDS

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ABSTRACT

When a container of liquid (e.g. water) oscillates vertically, it is possible that bubbles in the liquid move downwards instead of rising. As the bubble moves downward, the pressure of the water increases and the volume of the bubble will decrease. Then the added mass decreases and the bubble accelerate downward. But when the bubble moves upward, the volume and the added mass will increase, and pressure decreases so the acceleration will decrease. The point is that every time when the bubble moves up; because of low acceleration, it will not go to its initial place. It means in each oscillation the bubble effectively goes down.

Keywords: *liquid , oscillation, bubbles, pressure*

1 Introduction

It was found in experiments in the late 1950s that, under certain circumstances, bubbles would remain suspended or even sink to the bottom of the tank. It has been suggested that this phenomenon could be a cause of early rocket failures due to collecting bubbles interfering with fuel sensors as they are cylindrical and vibrating vertically in the rockets and causing premature stage separation [1]. Bubble media are actively used in the processes of purification of melts by the passage of insoluble gas bubbles through them. Bubbles are believed to be insoluble in the liquid. The effects occurring at the interface between a bubble and the liquid and the kinetics of bubble merging are excluded from consideration [2].

2 Experimental Setup

To do our experiments we used a 4-ohm speaker as the vibrating device which the dust cap is removed, a 30-watt amplifier, containers with 2.5 cm in diameter and different heights (6, 7.4, 10.5, 12.1 cm) and caps. To place the containers on the speaker, they were stuck to a cap and put in the cavity of the speaker (Fig. 1).

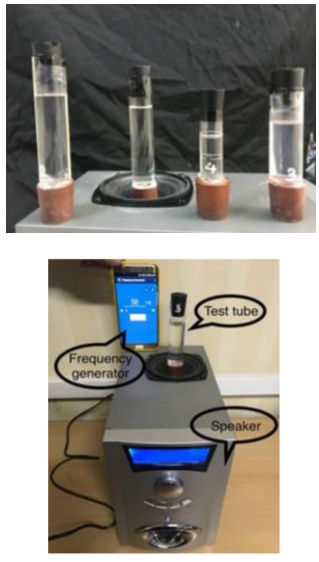

Fig. 1: Experimental Setup

3 Methods and Theory

We consider the container oscillates with amplitude "A" and "ω" which the position of the container is $x = A\sin\omega t$ and its acceleration is $\ddot{x}$. The total acceleration of the bubble is the sum of gravity and the acceleration of the vibration (Eq. 1-3). The data analysis will be by tracking the bubbles (Fig. 2).

$$\text{Displacement}=x = A\sin\omega t \quad (1)$$

$$\text{Sinusoid alacceleration}=\ddot{x} = A\omega^2\sin\omega t \quad (2)$$

$$\text{Total acceleration}=g + A\omega^2\sin\omega t \quad (3)$$

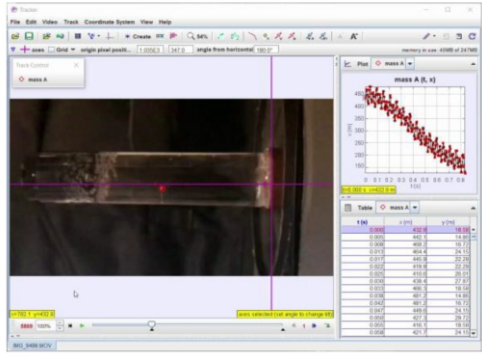

Fig. 2: Tracking the bubbles in our experimental setup

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